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Agriculture & Forestry Sector GHG Reduction Policy Options

Prepared for TWG Call #6, December 1, 2005

Potential Emission Reductions *	Potential Cost or Cost Savings *
High (H): At least 1 Million Metric Tons (MMT) carbon dioxide equivalent (CO_2e) per year by 2020 (~1% of current AZ emissions)	**High (H)**: $50 per Metric Ton CO_2e ($MTCO_2e$) or above
Medium (M): From 0.1 to 1 MMT CO_2e per year by 2020	**Medium (M):** \$5-50/$MTCO_2e$
Low (L): Less than 0.1 MMT CO_2e per year by 2020	**Low (L):** Less than \$5/$MTCO_2e$
Uncertain (U): Not able to estimate at this time	**Cost Savings**: Options that save money, i.e., that have "negative costs."
	Uncertain (U): Not able to estimate at this time

***** "Potential" here connotes rough initial estimate based in part on experience in other states. Also, several measures may overlap in terms of emissions reductions and/or cost impacts. Estimates assume measures would be implemented independently from other measures.

Definition of Priorities for Analysis:

- **High:** High priority options will be analyzed first.
- **Medium:** Medium priority options will be analyzed next, time and resources permitting.
- **Low**: Low priority options will be analyzed last, time and resources permitting.

**** Options marked with a double asterisk (**) indicate options that are at least partially "base case" policies, i.e., that have been or are likely to be implemented at some level in Arizona.**

Comments or priorities highlighted in yellow were discussed and affirmed during the Arizona Climate Change Advisory Group (CCAG) Meeting on September 29, 2005. CCAG meeting summary is posted at: http://www.azclimatechange.us/ewebeditpro/items/O40F7161.pdf

Option No.	GHG Reduction Policy Option	Priority for Analysis	Potential GHG Emissions Reduction	Potential Cost or Cost Savings	Ancillary Impacts, Feasibility Considerations	Notes
	Agriculture – Production of Fuels and Electricity					
1.1	Manure Digesters (methane recovery and electricity production)	High	Medium	Neg to Low	• Linked with Option 2.2 below	•
1.2	Biodiesel Production (incentives for feedstocks and production plants)	Medium	Medium	Med to High	• Production from both virgin and waste vegetable oils; • Seed oil production in AZ feasible (e.g. soy and rapeseed)?	
1.3	Biomass Feedstocks for Electricity or Steam Production	High	Low	?	• Need to identify viable feedstocks and volumes [e.g., crop residue (wheat straw, corn stover) or energy crops (switchgrass); • Linkage to Energy Supply TWG to determine availability of biomass plants • Linkage to RCI TWG to identify available capacity for biomass generated steam	1.
1.4	Ethanol Production	High	Medium	Med to High	• Current debate on the energy required for ethanol production	•

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1.5	Convert Diesel Farm Equipment to LNG/CNG or Hybrid Technology	Medium	Low	Med to High	• LNG/CNG engines or engine conversions reduce BC emissions • Availability of diesel hybrid equipment for farm applications?	•
1.6	(Additional option, if/as suggested)				•	•
1.7	(Additional option, if/as suggested)				•	•
	Agriculture – Fertilizer and Manure Management					
2.1	Nutrient Management (improve efficiency of fertilizer use)	Low	Medium	Low	• Note Ag. Best Management Practices under AZ State Rule R18-9-202 • Linked to Option 3.4 below.	•
2.2	Manure Management (practices to reduce methane emissions)	High	Medium	?	• Linked with Option 1.1 above. • Existing waste containment requirements for animal feeding operations > or = 1,000 head. • Could include composting and other measures. • Most of the benefit achieved at dairies. • Co-benefits include reduction of ammonia and VOC emissions.	

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2.3	Change Feedstocks (optimize nitrogen for N_2O reduction)	High	Low to Medium	Low	• Most of the benefit achieved at feedlots. • Co-benefits include reduction in ammonia emissions.	• Talk further with Bas
2.4	Reduce Non-Farm (Residential and Commercial) Fertilizer Use	High	?	?	• Emissions from non-farm application are not currently in the inventory; unclear what the reductions and costs would be.	•
2.5	(Additional option, if/as suggested)				•	•
2.6	(Additional option, if/as suggested)				•	•
	Agriculture – Soil Carbon Management					
3.1	Conservation Tillage/No-Till (carbon sequestration and reduced energy use)	Medium	Medium	Low	• A.R.S. §49-457 (Best Management Practices) • Boll Weevil eradication program requires cotton residue to be plowed under (conservation tillage not applicable to cotton)	•
3.2	Reduce Summer Fallow (increase soil C content, reduce N_2O emissions)	Low	?	?	• Applicability to AZ? • Need estimates of fallow summer acreage	
3.3	Increase Winter Cover Crops (increase soil C content, increase soil N content)	Low	?	?	• Applicability to AZ? • Need estimates of winter acreage available for cover crops	2.

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3.4	Improve Water and Nutrient Use (to minimize soil C loss)	Low	Low	Low	• Linked to Option 2.1 above; Suggest combining these two.	•
3.5	Rotational Grazing/Improve Grazing Crops and/or Management	High	Low	Low	• Applicability to AZ?	• Level of impact? (Talk further with Bas) • Use of land by grazing may prevent loss to development.
3.6	(Additional option, if/as suggested)					•
	Agriculture – Land Use Change					
4.1	Convert Land to Grassland or Forest	High	Medium	?	• Opportunities for conversion in AZ?	•
4.2	Reduce Permanent Conversion of Farm and Rangelands to Developed Uses	High	High	?	• Reductions occur both from higher retention of carbon in soil and lower transportation activity. • Linked to Option 4.3. • Linked to Smart Growth Options in the TLU TWG.	•
4.3	(Additional option, if/as suggested)					•
4.4	(Additional option, if/as suggested)					•
	Agriculture – Farming Practices					
5.1	Organic Farming	Med	Medium	Low	• Reductions occur via lower intensity agricultural practices (nutrient/pesticide application, reduced tillage)	•
5.2	Programs to Support Local Farming/Buy Local	High	Medium	?	• Reductions occur through lower transport related emissions.	• Refer to CSA and transport freight initiative
5.3	(Additional option, if/as suggested)				•	•

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5.4	(Additional option, if/as suggested)				•	•
	Forestry – Biomass Protection and Management					
6.1	Forest Protection – Reduced Clearing And Conversion to Nonforest Cover	High	High	Low	• depends on business as usual rates of land clearing and viable alternatives	•
6.2	Increase Maintenance of Urban and Residential Trees	Medium	Low	Low to high	•	•
6.3	Afforestation of Nonforested Rural Lands	Low	Low to high	Low	• depends on available acreage and risk	•
6.4	Afforestation of Nonforested Urban Lands	Low	Low to high	Low	• depends on available acreage and risk	•
6.5	Reforestation/Restoration of Forested Lands	High	Low to high	Low	• depends on available acreage and risk	•
6.6	Reforestation or Increased Densification of Stands	Low	Low to high	Low	• depends on available acreage and risk	•
6.7	Age Extension of Managed Stands	Medium	Low	Low to high	• involves significant tradeoffs with carbon savings from harvested wood products, as well as ecological risk	•
6.8	Thinning and Density Management of Managed Stands	High	High	Low to high	• cost and technology barriers to market use of harvested biomass may be high; supply potential is high	•
6.9	~~Fertilization and~~ Waste Recycling	Med	Low	Low to high	• site and situation specific	•
6.10	Expand Short Rotation Woody Crops (for fiber and energy)	Low	Low to medium	Low to high	• depends on available acreage and market demand	•

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6.11	Expanded Use of Genetically Preferred Species	Low	Low	Low	• primary issues in the southwest are reductions of fuel load and restoration of native species	•
6.12	Modified Biomass Removal Practices (reduced decay and energy use)	High	Low	?	• may be opportunities to use biofuels for equipment	•
6.13	Fire Management and Risk Reduction Programs	High	High	Low to high	• implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse	•
6.14	Ecosystem Health Risk Reduction Programs (pest/disease, invasive species)	High	High	Low to high	• implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse	•
6.15	Drought Management Programs (tree selection, placement, protection)	High	High	Low to high	• implementation and market barriers may be significant, potential is high if biomass is directed to constructive reuse	•
6.16	Flood and Riparian Management Programs (tree selection, placement, protection)	High	Low	Low to high	• depends on available acreage	•
6.17	Watershed Management Programs (stand retention, enhancement and management)	High	Low to high	Low to high	• depends on available acreage and forest health issues	•
6.18	Habitat Management Programs (stand retention, enhancement and management)	High	Low to high	Low to high	• depends on available acreage and forest health issues	•

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6.19	Re-conversion of woodlands to grasslands (e.g. pinon pine and juniper encroachment)	High	TBD	TBD	• what are the carbon implications of wood/shrubland conversion from grasslands? • Not all TWG members think this is a high priority	•
6.20	(Additional option, if/as suggested)				•	•
	Forestry - Wood Products and Waste				•	
7.1	Improved Mill Waste Recovery	High	Low to high	Low to high	• technology and market dependent	•
7.2	Improved Logging Residue Recovery	High	High	Low to high	• technology and market dependent	•
7.3	Expanded Use of Small Diameter Trees for Wood Products and Energy	High	High	Low to high	• technology and market dependent	• Merge with Forest Management
7.4	Expanded Use of Wood Products for Building Materials	High	Medium to high	Low to high	• technology and market dependent	• Target to small diameter trees
7.5	Expanded Use of State and Locally-Grown Wood Products	Medium	Low to high	Low to high	• technology and market dependent	•
7.6	(Additional option, if/as suggested)				•	•
7.7	(Additional option, if/as suggested)				•	•
	Forestry – Energy Production				•	
8.1	Expanded Use of Forest Biomass Feedstocks for Electricity (fuel switching)	High	High	Low	• technology and market dependent	• Target to Forest Management
8.2	Improve Use and Efficiency of Wood for Direct Commercial Heat and Energy	High	High	Low	• technology and market dependent	• Target to Forest Management
8.3	Improved Energy Capture from Wood Waste Combustion	High	Low to high	?	• technology and market dependent	• Target to Forest Management

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8.4	Expanded Landfill Methane Recapture (wood products waste)	High	Low	Neg to Low	• Federal New Source Performance Standards and Emissions Guidelines require methane capture at larger landfills.	• Refer to RCI
8.5	Improved Commercialization of Biomass Gasification and Combined Cycle	High	Low to high	Medium to high	• requires improved technology and market incentives	• Refer ES
8.6	Expand Usage and or Efficiency of Wood Waste as Residential Fuel Source	High	Low - Medium	Low	• Overlap with RCI sector.	• Target to Forest Management